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before the

Select Committee on Energy Independence and Global Warming
United States House of Representatives
April 14, 2010

I thank Chairman Markey, Ranking Member Sensenbrenner and other members of the committee for this opportunity to testify on the role of coal and coal-related technology in meeting the nation's needs for clean energy and for reducing greenhouse gas emissions. Coal and coal-related technologies are at the heart of the Committee's two primary charges: Energy Independence and Global Warming.

I have organized my statement to the Committee into four discussion areas:

- General background material on current and projected coal use and climate implications
- Principles that Arch Coal supports in the development of climate policy
- The role of advanced coal technologies in greenhouse gas emission reductions, especially carbon capture and storage (CCS)
- How the potential of advanced coal technologies can be realized

General background information on coal and coal emissions

Coal is a major contributor to the energy mix in this country, and in the world. Coal contributed 23% of the energy consumed in the U.S. in 2008, and 27% of the energy consumed in the world in 2006 (USDOE/EIA AER-2008). In the U.S., the vast majority of coal consumption is for electric power generation. Coal was used to generate 48.5% of the electricity generated in the U.S. in 2008 (USDOE/EIA AER-2008), and 40% of the global production of electricity in 2005 (International Energy Agency, ETP-2008). The world relies on coal because it is abundant and inexpensive – typically a small fraction of the cost of oil, natural gas, or biomass. The fact that the U.S. relies so heavily on coal is a large part of the reason that, in 2006, U.S. consumers paid about 58% of what Japanese consumers paid for electricity. In France, the U.K., Germany, Italy, and Denmark the fractions were 72%, 56%, 72%, 46%, and 32% (USDOE/EIA website, data compared in US dollars per kilowatthour).

The benefits of coal use to the U.S. economy are substantial. A 2006 report by Dr. Adam Rose (The Economic Impacts of Coal Utilization and Displacement in the Continental United States, 2015) concluded that "in 2015, U.S. coal production, transportation, and consumption for electric power generation will contribute more than $1 trillion of gross

output … to the economy of the lower-48 United States." Coal and coal-based electricity are clearly key components of our energy mix and our economy.

China is an important player in global coal markets. In 2006, while the U.S. consumed 22 Quadrillion Btu's of coal, 90% for power generation, China consumed 25 Quadrillion Btu's of coal for electricity, and another 24 Quadrillion Btu's in its industrial sector, and a final 3 Quadrillion Btu's in residential and commercial sectors. All told, China burned over twice as much coal as the U.S. in 2006 (USDOE/EIA IEO-2009). More current estimates are that Chinese coal use is now three times that of the U.S., and continues to grow at about 20% of the total U.S. coal consumption rate each year. With China leading the way, non-OECD nations constitute 63% of current world coal use, and are projected by DOE/EIA to contribute 94% of the growth in world coal use between 2006 and 2030 (USDOE/EIA AEO-2009). We have all heard the anecdotes about energy growth in Emerging Asia, and most of them are true. China is building approximately one new coal-based power station every week. China has been adding the equivalent of the entire power grid of the UK each and every year. Chinese car sales exceeded U.S. car sales for the first time ever in 2009.

Consider the prospect of China, which had a private car ownership rate of 4 cars per 1000 people in 1999, compared to about 700 vehicles per 1000 people in the U.S. or 400 vehicles per 1000 people in South Korea, growing in vehicle intensity to just the South Korean rate. That is over 500 million vehicles. If those vehicles are fueled with petroleum, the impact on global oil markets would be very large, not to mention the impact on CO2 emissions. If the sector were dominated by electric vehicles, then the implications for power generation, coal combustion and climate are equally significant, in the absence of effective and affordable CCS technology.

And it's not just China. In fact, coal has been the fastest growing fuel source on the planet this past decade – with global coal consumption up a staggering 41% in just the past eight years. To put U.S. coal consumption into perspective, the U.S. accounts for just one seventh of global coal use today – and that fraction is shrinking rapidly as coal consumption around the world grows, while U.S. consumption remains roughly constant.

So, why is the world turning to coal? Above all, it is because coal is the fuel source that the world's fastest growing economies – China and India in particular, but Russia and Indonesia and most of the rest of the developing world as well – have in greatest abundance. None of their actions support – and I believe it would be naïve of us to think – that such countries will turn their backs on such a vast storehouse of reliable, secure and low-cost energy.

In fact, with competition for energy resources intensifying, such countries are even beginning to look beyond their own borders for fossil energy resources, including coal. During the past year, we have seen state-operated Chinese and Indian companies acquire coal reserves and mines in other countries, with the view of ensuring a sufficient source of energy for the decades to come. Private Chinese, Indian and Russian steel and energy companies are following this same strategy.

Coal's future is not resource-constrained. EIA estimates that the world has 929 billion tons of recoverable coal reserves, enough for about 137 years of production at current rates, and the U.S. has the greatest share of those reserves, about 28% of the global total. By providing affordable heat and power, coal has raised – and is continuing to raise – the standard of living and quality of life for literally billions of people.

Arch Coal takes pride in the fact that we produce about 16% of the coal mined each year in the U.S., providing fuel for about 8% of our national electricity generation. But we also recognize that coal is a major contributor to manmade emissions of greenhouse gases. Arch Coal is committed to playing a constructive role in helping advance federal legislation that both addresses climate concerns and preserves the tremendous economic and human benefits associated with low-cost and secure energy from coal.

Recommended principles to follow in addressing global warming

Arch Coal supports legislation to reduce global greenhouse gas emissions. We believe that this can be done in a manner that maintains U.S. and global prosperity, and that the two most important keys to this are the timing of reductions and a collaborative government/industry effort to commercialize improved, lower cost emission mitigation technologies. I would offer that CCS technologies and their global deployment provide the only technologically feasible and politically achievable path for stabilizing CO2 concentrations in the atmosphere within the next 40 years. We must recognize that even if we could eliminate 100% of the CO2 emissions in the U.S., it would not stabilize CO2 concentrations in the atmosphere. We must develop CCS technologies that can be shared and deployed around the globe.

Our recommended strategy to address global warming includes the following principles:

Provide reasonable targets and timetables. Elements of this principle include recognition that not all the technologies needed to achieve long term goals are available, and will require time to mature and penetrate markets. Also embodied in this principle is the need to establish national policy with a single federal climate program – thus avoiding duplicative or overlapping measures, or a patchwork of state and tort-based activities.

Maintain America's competitiveness in the global economy. This principle goes beyond the basic components of targets and timetables, and includes measures to assure effective cost-containment such as a compliance safety valve or ceiling price for carbon that is certain, reasonable, economically achievable, and consistent with the need to allow time for emerging mitigation technologies to achieve commercial viability before requiring broad deployment. In addition, any program should encourage the expedited development and use of domestic and international offset projects to ensure progress in reducing global emissions at minimal cost.

Foster development and deployment of emerging low-emission technologies. There are a number of these, but for coal and natural gas the key technology is CCS. We must forge

public/private sector partnerships now to invest in carbon capture, transport, storage, and conversion to beneficial uses. We must address the regulatory framework under which such technologies would be structured, including rules for injection and long-term stewardship and liability issues. The timing of reductions and introduction of emission standards must, when considered together with financial incentives, serve to encourage and not frustrate early deployment of the technology.

Promoting improved technologies to reduce emissions from coal

Technology is the solution

It has been stated repeatedly in recent years that there is no silver bullet in addressing the climate challenge. We disagree. We believe that there is in fact a singular solution – albeit a multi-faceted one – and that solution is technology. This concept is not original with Arch Coal; it was well presented in Ending the Energy Stalemate, a December 2004 report by the National Commission on Energy Policy. NCEP concluded, correctly we believe, that current technologies were not up to the task of providing the needed reductions in greenhouse gases, and recommended setting aside a portion of "cap and trade" allowances for technology development. Advanced coal use technologies and carbon capture and storage (CCS) were both explicitly identified by NCEP as important to this technology development concept. Since the NCEP report, most comprehensive climate change mitigation bills have included measures to recycle a portion of compliance revenues to reduce the cost of advanced coal-based technologies, although it should be noted that CCS is applicable to any fossil fuel, and not limited to power production.

Of course, the list of ways in which technology can and should be brought to bear in meeting today's energy challenges is a lengthy one. We need to harness technology to help consumers use power more prudently and cost-effectively; to store energy from intermittent renewable resources such as wind and solar; to boost thermal efficiencies at power plants; and to facilitate the electrification of the automotive fleet, to name just a few. But perhaps most importantly, we must commercialize CCS technology.

The National Research Council, whose members are drawn from the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine, published a seminal report last year, America's Energy Future: Technology and Transformation. This report evaluated "current contributions and the likely future impacts … of existing and new energy technologies." The report recommended a portfolio approach to meeting technology needs in the electricity sector and concluded "two key technologies must be demonstrated during the next decade to allow for their widespread deployment starting around 2020:

- Demonstrate whether CCS technologies … are technically and commercially viable for application to both existing and new power plants. This will require the construction before 2020 of a suite (~15-20) of retrofit and new demonstration plants with CCS …."

- Demonstrate whether evolutionary nuclear plants are commercially viable in the United States …."

A failure to demonstrate the viability of these technologies during the next decade would greatly restrict options to reduce the electricity sector's CO2 emissions over succeeding decades. The urgency of getting started on these demonstrations to clarify future deployment options cannot be overstated."

In the developed world, we often hear that carbon capture and storage technology will be necessary in order for coal to continue to be used. The background information presented above should make it abundantly clear that nothing could be further from reality. The facts are that the world will continue to use coal, period – massively and in rapidly growing volumes. The question is not whether global coal use will continue and grow, but rather, whether emissions from coal will grow. The answer to that question will hinge on our ability to make CCS technology effective, and just as important, affordable.

The rest of the world has reached the same conclusion. In a recent report entitled Breaking the Climate Deadlock: A Global Deal for Our Low-Carbon Future, Former UK Prime Minister Tony Blair summed it up as follows: "The vast majority of new power stations in China and India will be coal-fired. Not 'may be coal-fired'; will be. So developing carbon capture and storage technology is not optional, it is literally of the essence."

We believe that helping bring CCS technology to maturation would represent an enormous contribution to the global effort to stabilize GHG concentrations in the atmosphere. If we can move the technologies forward and drive down their costs, we can not only address our domestic greenhouse gas emissions more effectively, but also equip the developing world with the kinds of tools that will provide an improved standard of living in a climate-compatible manner.

Furthermore, there is already an excellent technological foundation in place upon which we can build. Virtually every aspect of carbon capture and storage has been proven to work, and many of the key pieces are currently being used at commercial scale. For instance, the U.S. is already injecting millions of tons of carbon dioxide into the ground each year to increase recovery in declining oil fields. Coal gasification – particularly for chemical production but increasingly for power generation – is widely deployed, and provides one avenue for isolating carbon dioxide from fossil fuel prior to combustion. American Electric Power – in what we view as a watershed event – recently began capturing carbon dioxide from a portion of the flue gas of its Mountaineer power plant in West Virginia and is currently injecting it underground for permanent storage. Through a project jointly funded by AEP and DOE, they have already begun planning on a commercial-scale version of the same technology on the same generating unit.

I must emphasize that CCS remains an emerging technology. There is still not a single commercial scale power plant in the world which captures its CO2 and injects it into a

geological formation for permanent storage. The planned project by AEP will inject 1.5 million tonnes per year of CO2 deep underground. Success at Mountaineer will be a major accomplishment, but we must remember that individual coal-fired generating units in the U.S. often emit over 6 million tonnes per year of CO2 – four times the rate to be captured by the Mountaineer demonstration project. As noted above, coal-fired power plants in the U.S. cumulatively emit over 2000 million tonnes of CO2 per year, so the scale of the challenge is large. Moreover, the current technology options are all quite costly, and there are aspects of the process which go beyond our current legal infrastructure, such as addressing long-term stewardship and liability for stored CO2.

Benefits of CCS

CCS technology offers three distinct types of benefits. The first, and most obvious, is that for the types of aggressive emission reduction goals that are currently being projected, it can greatly reduce compliance costs. The second is a corollary benefit: that by reducing costs, CCS enables society to seek larger overall emission reductions. It should be noted that these first two benefits are associated with all fossil fuels used with large stationary sources, not just coal. The third type of benefit is that by making an abundant low cost energy resource compatible with environmental goals, CCS allows the world to continue to derive the economic and geopolitically stabilizing benefits associated with coal.

The International Energy Agency, in Energy Technology Perspectives – 2008, a report prepared to support the G8 Plan of Action on climate change, stated **"CO2 capture and storage for power generation and industry is the most important single new technology …."** In IEA's modeling, CCS accounted for 19% of global CO2 reductions. Perhaps just as important, IEA evaluated multiple scenarios, and the cost of climate mitigation in a world *without* CCS was 97% more expensive than a scenario in which CCS was assumed to be demonstrated and affordable.

CCS technology is important because the electric power sector is crucial to meeting climate change goals, and because coal dominates U.S. and global power generation. The DOE/EIA analysis of H.R. 2454 concluded that "The vast majority of reductions in energy-related emissions are expected to occur in the electric power sector." For the main scenarios evaluated by EIA, the power sector contributed 80-88% of such reductions. EPA's analyses project that U.S. electricity prices, which averaged about 10 cents per killowatthour for residential customers in 2007, will increase about 80% (in constant dollars) by 2050 under HR. 2454, and by nearly 100% if critical power technologies, including CCS, are unavailable. (EPA did not evaluate the impact on electricity prices of substantial reductions in the cost of CCS.) Hence, CCS technology is crucial to both achieving targeted emission limits, and for making the global warming mitigation program affordable.

In February 2009, BBC Research and Consulting conducted a study for four major labor unions and the American Coalition for Clean Coal Electricity. The study examined the micro-economic and employment effects of deploying CCS technology on just one-fourth

of the U.S. coal-based generation fleet. Effects evaluated included the economic activity associated with the construction and operation of the power plants with CCS, the suppliers and support services industry for those units, and "induced effects" – the jobs created by purchases by employees in the first two categories such as for homes, automobiles, and groceries. BBC concluded that this initial CCS deployment would result in 5.5 – 7.0 million job-years, and after the massive ($300-400 billion) construction period was concluded, 175,000 to 250,000 permanent jobs to operate the technology.

BBC did not include an analysis of the job impacts of further research to drive down CCS costs, making electricity less costly than otherwise, and thereby improving American competitiveness in global markets. Neither did it consider the beneficial impact on capital markets of being able to retrofit existing power plants with CCS, rather than replace them with new power plants using other technologies, such as nuclear energy. Of course, reduced demand for energy capital means more capital is available for other job-producing investments. Such "macro-economic" benefits could greatly exceed the direct employment impacts. One could argue that if CCS achieved its ultimate goal of both domestic and international deployment, then that American advantage would be lost. However, there is a more persuasive argument that such success would yield even greater benefits in resolving the global climate problem, and in providing greater prosperity for all through a global reduction in basic energy costs.

The National Coal Council, an official Federal Advisory Committee to the Secretary of Energy, took a longer view on the benefits of CCS in its December 2009 report, Low-Carbon Coal: Meeting U.S. Energy, Employment and CO2 Emission Goals with 21st Century Technologies. The report concluded that "Extensive deployment [through 2050] of coal-based generation with CCS will have far-reaching socioeconomic benefits, yielding **over 28 million job-years** from new construction and revitalizing the industrial sector of the U.S. GDP will be increased by **$2.7 trillion**. Further, continuing operation and maintenance of the facilities would support over **800,000 permanent jobs**." [emphasis in original]

One might believe that *any* of the emerging "green" technologies would reduce mitigation costs and create jobs in America. However, not all technologies are created equal, and the current existing generating base and energy infrastructure provide an inherent advantage to some technologies. Whereas wind turbines and solar systems can easily be imported from overseas, the U.S. clearly has the global lead in CCS technology. And the coal and most of the natural gas that fuels CCS-equipped power plants in the U.S. will be produced in the U.S. – with obvious security of supply implications – helping our economy and providing domestic employment.

A final benefit of CCS technology, generally missing from current analyses, is its ability to reduce emissions from the transportation sector. If you carefully examine EPA's analysis of H.R. 2454, you will find that petroleum use remains relatively constant through 2050. While we seek an 83% reduction in greenhouse gas emissions, in the face of a growing population and increasing prosperity, the best that improvements in mileage can provide is the ability to stay even with current emissions. Electric vehicles could

disrupt this environmental stagnation, both domestically and globally. But the increased consumption of electricity to displace oil used in the transportation sector must come from additional generating capacity. Multiple sources will be needed, and coal with CCS is certainly capable of contributing in a significant way. Success in substituting electricity for oil conveys benefits that go beyond mitigation of global warming. It is easy to see that the rise of Asian economies will place ever increasing pressure on limited supplies of crude oil and transportation fuels, often produced by countries that do not like us. The potential for CCS to relieve some of that pressure should not be casually overlooked.

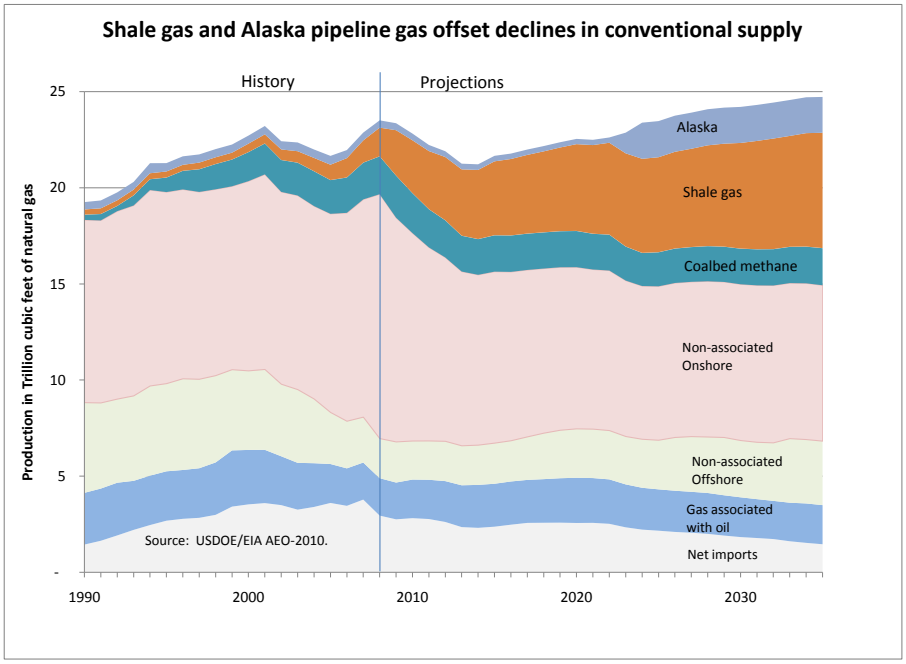
Realizing the potential

So, how should we proceed? Based on the principles articulated above, Arch believes that near- and mid-term targets should be harmonized with technology availability, which suggests a more modest target in 2020. Moreover, we believe it is imperative that we put in place cost containment mechanisms that provide greater certainty. We applaud Chairman Waxman and Chairman Markey for allowing the expansive use of offsets in meeting compliance targets – although we would have preferred fewer restrictions and limitations on those offsets. But we remain very concerned that the projected offsets market would prove to be far less robust and liquid than currently envisioned. If that proves to be the case, the cost of compliance would likely increase dramatically, as the EPA analysis suggests.

Timing is crucial. One of the greatest dangers to affordable long-term solutions is that overly aggressive near-term targets would prompt power generators to look for a short-term fix by turning to more expensive but lower-carbon fuels such as natural gas. We have been down that path before – in the first years of this decade – and the result was higher power costs and lower reliability. The National Academies of Science just released a report on America's Energy Future in which they cautioned against just such thinking. In the end, to reach the goals in recent legislative proposals and supported by various studies, we will need to apply CCS to natural gas-based power systems as well as coal-based power systems. A sudden "dash to gas" would likely eliminate interest in longer-term application of CCS, and the technology would freeze in its current state of development. All this brings me back to the key point, which is that without robust CCS technologies we cannot stabilize CO2 concentrations in the atmosphere within the next 40 years.

Moreover, we believe that the jury remains out regarding future gas supplies. We have read recent reports heralding large new supplies of unconventional "shale" gas. But we have also read the DOE/EIA 2010 Annual Energy Outlook. The figure below, taken from that report, shows that unconventional gas production is, indeed, projected to increase over the next two decades. The figure also shows that EIA believes *conventional* natural gas production is going to decline at about the same rate as the increase in *unconventional* shale production. The net projected increase, after 20 years, is only 2 quadrillion Btu's of gas above the rate produced before the current recession, about 9% of the energy currently associated with coal-based power production. So even

if all of this additional gas went to power production, which currently consumes about one-third of total U.S. natural gas consumption, it would not make a major change in coal use.



With respect to CCS, Arch believes that this technology is essential to meeting climate goals, and to assuring an affordable solution. We would encourage Congress to take the steps necessary to work with industry to accelerate the timeline for widescale deployment of this crucial technology.

Arch supports the underpinning pro-technology philosophy of the 2004 NCEP report, and most comprehensive climate bills proposed since then, and recommends:

- A substantial government/private sector collaborative effort to construct a significant number of power plants using CCS with saline geologic storage to demonstrate a portfolio of CCS technologies, and
- Continuing R&D and further cost-sharing by government on a large initial deployment of CCS facilities, on both new and existing fossil fuel based power plants, and
- Creation of a legal framework for CCS that overcomes recognized *non-technology* barriers to the technology, including certainty in the environmental rules that apply to CCS and long-term liability.

Elements of the above concepts can be found in HR. 2454, but perhaps the most complete CCS legislative proposal to date is found in a draft bill released on March 22 by Senators Rockefeller and Voinovich. This discussion draft includes:

- Continued government support for the DOE CCS research and development program.
- A CCS "Pioneer" program to supplement the DOE CCS demonstration program, with an immediate effort to demonstrate 20 GW of CCS systems. Private sector costs for these units would be supplemented by a "wires charge" placed on sale of fossil-based electric power, by federal loan guarantees, and by tax incentives.
- An "Early Adopter" program to provide tax incentives to foster deployment of another 62 GW of CCS systems.
- A performance standard that would require all new coal-based power plants to use CCS technology, once the above programs have demonstrated that the technology is effective and reliable.
- A placeholder for future language addressing the long-term liability issue.

Arch is optimistic about the Rockefeller-Voinovich package because it could move forward immediately. We should not squander valuable time needed to advance this critical technology.

An alternative approach to greatly increase the number of CCS demonstration facilities in the short term and reduce the amount of CO2 released per unit of energy consumed would be to expand current legislative proposals for a federal renewable electricity standard to include other clean electricity options: specifically, fossil fuel generation with CCS, advanced nuclear power generation, and improved efficiency at existing power generation facilities. This broadening of the RES was rejected by the Senate Energy Committee, but Arch continues to believe that it would be a pragmatic mechanism to establish a portfolio of improved low carbon options from which new generation markets could choose.

These recommendations constitute a pragmatic action plan to achieve aggressive environmental goals, both domestically and globally, without sacrificing economic prosperity. The proposals outlined above would allow the nation to begin building CCS systems at a pace that would otherwise be unachievable. Industry has repeatedly demonstrated its support for this technology-based solution to global warming, but we need to see shared determination and support from the federal government to get the job done.